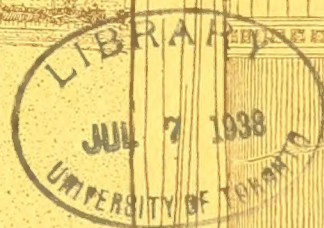
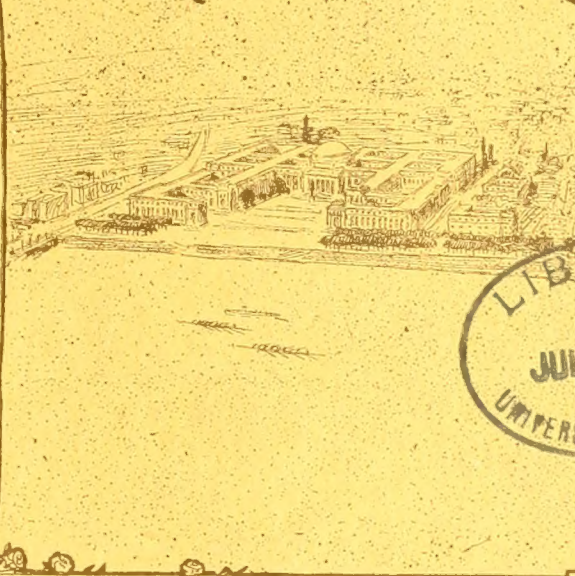


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The TECHNOLOGY MONTHLY ENGINEERING JOURNAL



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Nov. 1916



Vol. III, No. 4

The Massachusetts Institute of Technology

CAMBRIDGE, MASS.

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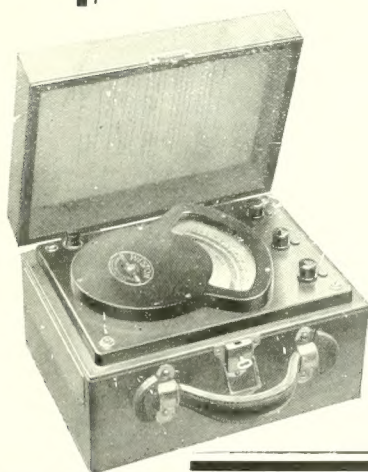
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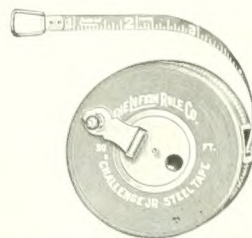
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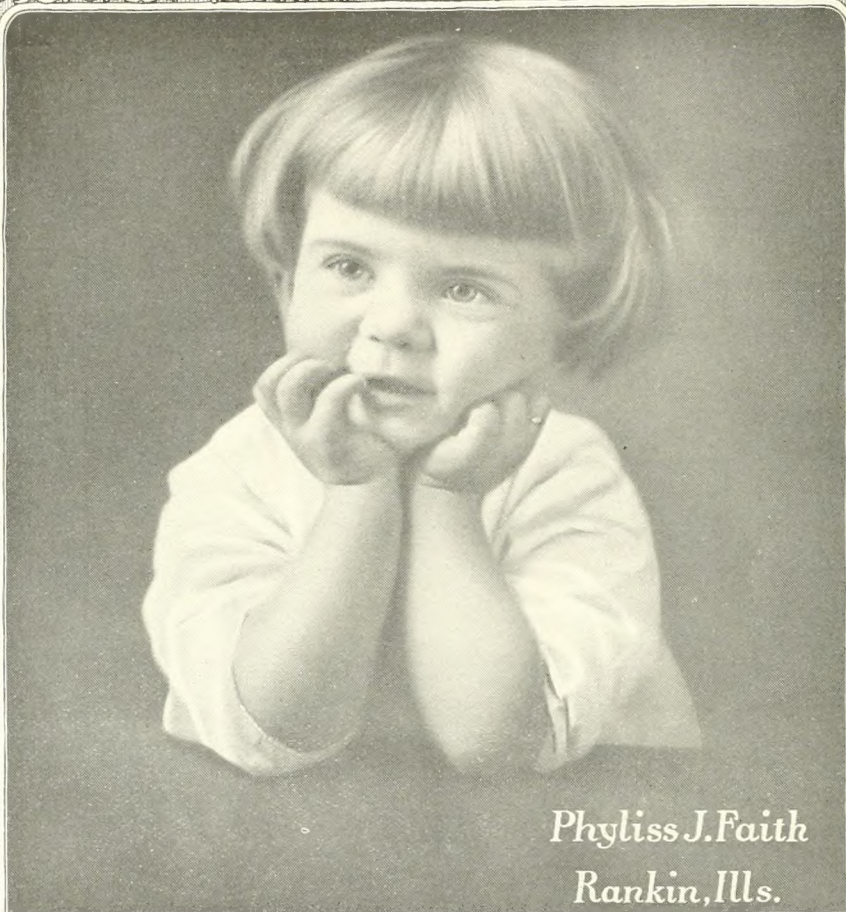
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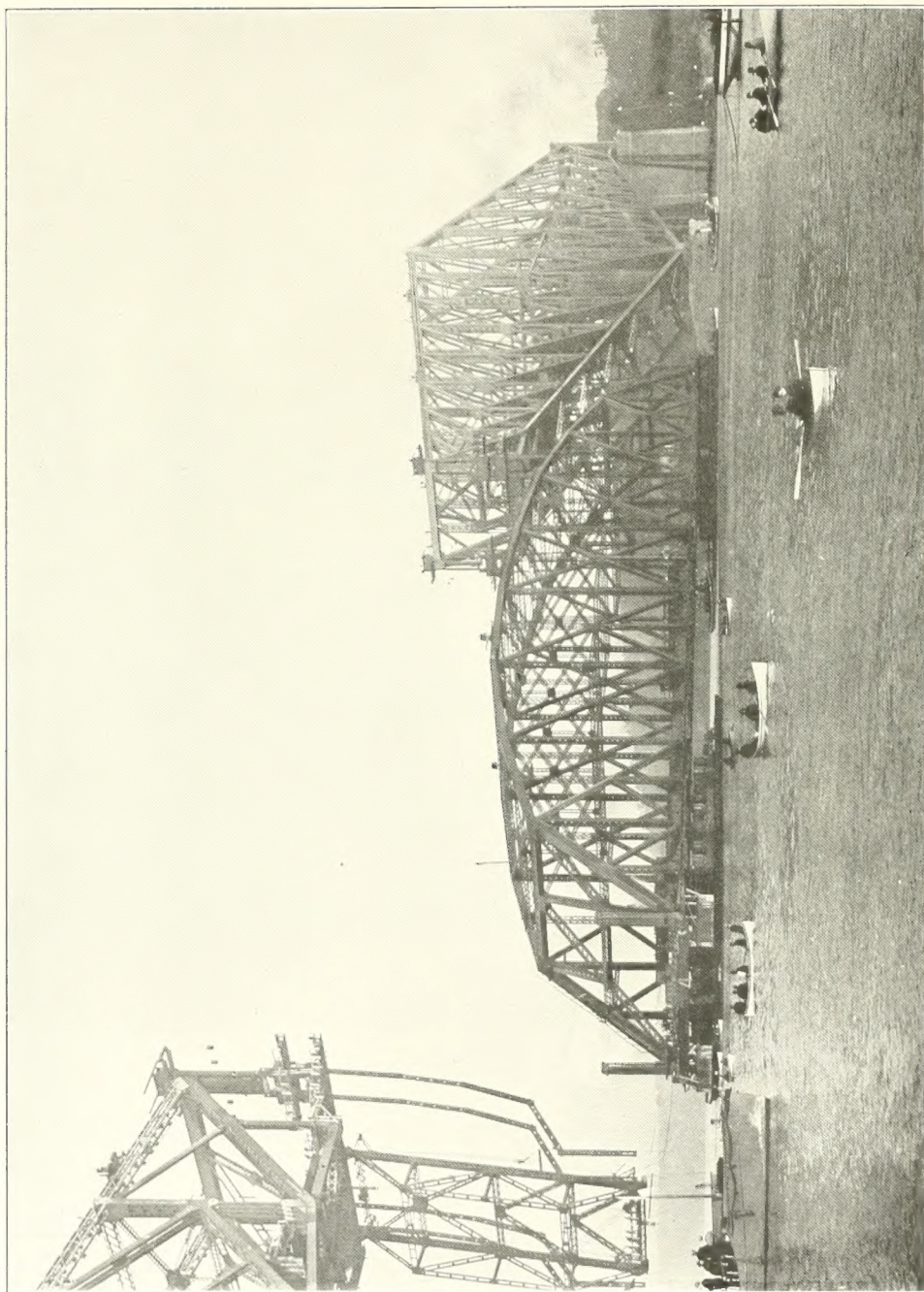
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SUSPENDED SPAN OF QUEBEC BRIDGE BEING FLOATED INTO PLACE

THE TECHNOLOGY MONTHLY ENGINEERING JOURNAL

VOL. III

CAMBRIDGE, MASS., NOVEMBER, 1916

NO. 4

THE QUEBEC BRIDGE

By WILLIAM B. UPDEGRAFF, H., '04

Engineer with the Watson-Stillman Company, New York City

Editor's Note. The surprise with which the Engineering Profession received the news of the Quebec Bridge disaster of this fall is known to you all. This article is written in the light of Mr. Updegraff's personal experiences. He spent about one month there, testing the entire equipment and seeing that the complete installation was operating satisfactorily, and was there at the time the span was lifted.

At the instant of the tragedy the author was standing on the end of one of the cantilever spans. His is the message that reads: "I went, I saw, I write!"

AT a point on the St. Lawrence River, about six miles west of Quebec, there stands today about ninety per cent of what will be, when finished, the greatest cantilever bridge in the world, and one of the greatest structural engineering achievements of the century; on September 11, 1916, at about 10 A.M. the remaining ten per cent of the structure, the suspended span, which had previously been practically finished, was being hoisted into place between the two great cantilever arms; the completion of the bridge, all but a few final details, appeared to be but a few hours distant; by eleven o'clock of that same day news had been flashed to all parts of the world that this same suspended span had torn loose from its supports and had crashed down, breaking and twisting as it fell to the bottom of the St. Lawrence River, where it will probably remain for the rest of time, a mangled wreck of over five thousand tons of nickel steel!

This is the second disaster that has occurred at this same spot: In 1907 the first bridge intended to span the

St. Lawrence had been finished almost half way across the river, extending from the south shore, when suddenly it collapsed, due to weakness in the bottom chords, and the entire superstructure fell, accompanied by a loss of seventy-seven lives. This bridge project was then abandoned, and such of the wreckage as could be cleared away was removed; that portion of the wreckage, about ten thousand tons, which had fallen into the water could not be removed, owing to the extreme depth of water (about 200 feet in the channel), and to the tidal current of from nothing to about eight miles per hour in either direction; these conditions made diving too hazardous to undertake, and as the wreckage lay well below the depth necessary for navigation no attempt has been made to raise any of the original structure; and the same holds good of the suspended span of the new structure.

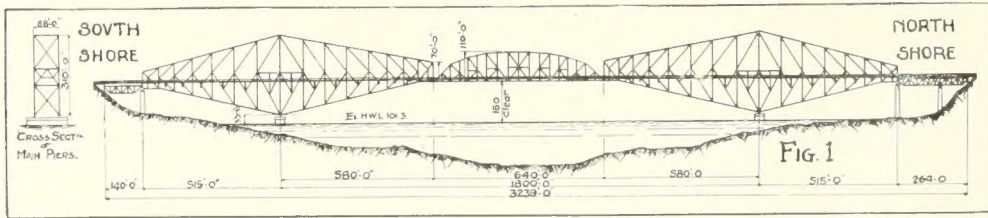
The extreme width of the river and the great depth of the channel are responsible for the difficulties to be encountered in building a great railroad bridge connecting the north and south shores of the St. Lawrence at this

point; this particular site was selected because here the river is narrower than at any other point where a transcontinental railroad bridge would be practical.

The present bridge is being built and erected by The St. Lawrence Bridge Co. from designs made by Mr. Phillips Johnson, President of the Company. When finished the Bridge will be owned by the Canadian Government Railway System, and it will eventually be used by eight railroads.

from the bridge site, towards Quebec. The span was built in such a position that six scows, especially built for the purpose, could be floated under the span and at the proper tide condition could float the span off its supports and the entire unit could then be towed to the bridge site.

Hanging, hinged from the end of each cantilever arm, were two steel trusses, 60 feet wide by 120 feet long: these trusses when hanging vertically formed a neat fitting opening slightly wider



SIDE ELEVATION OF BRIDGE GIVING PRINCIPAL DIMENSIONS

The distance from shore to shore, at the track level is 3239 feet, while the two piers on which the great cantilevers rest are 1800 feet from center to center, no intermediate supports being possible. To span this distance a double cantilever structure with the necessary approach spans, and a center span suspended between the ends of the two cantilever arms has been provided. The principal dimensions are shown on the diagram Fig. 1. The center posts are 310 feet high above the piers, or approximately 350 feet above tidewater. The anchor arms and approaches are built of carbon steel, but the cantilever arms and suspended span are built entirely of nickel steel (excepting a very few unimportant members). The suspended span alone is a good size bridge, 640 feet long, 88 feet wide, and 110 feet high, and weighing 5100 tons.

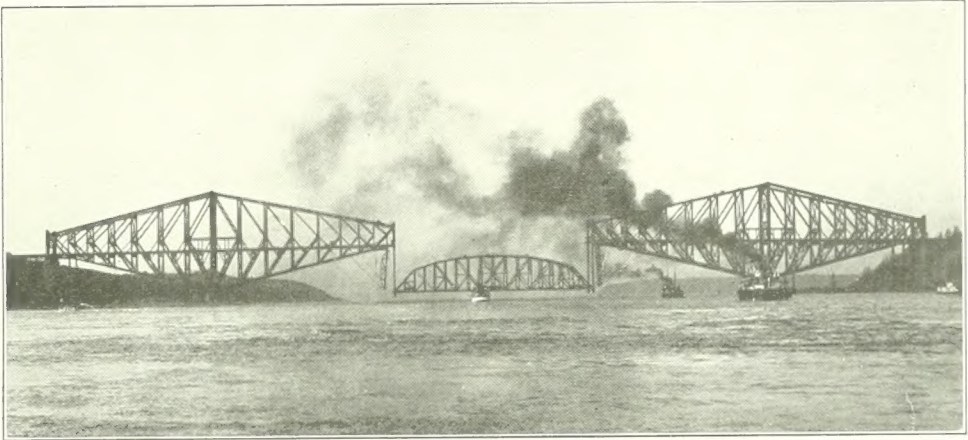
This span was erected on false work at Sillery Cove, about 3 1-2 miles

than the length of the center span. On their lower ends they were provided with the necessary rigging for mooring the span accurately in place under the lifting equipment, and the entire mooring truss equipment is of sufficient strength to withstand any side stresses, due to tide and wind, which might arise during the lifting of the span. Provision was made for pulling the lower ends of the mooring trusses shorewards, to permit of an increased width of opening for the reception of the span when it was towed into place. As soon as the span was floated about central between the cantilevers and all mooring lines made fast, these trusses were gradually lowered and the lines tightened up until by careful maneuvering the span was held stationary immediately under its intended location between the cantilevers.

Eight massive chains, each made of double bar links 30 inches wide, 2 1-4

inches thick and 30 feet long, reached from four overhead jacking units to a point about 30 feet above high water; these chains were accurately bored on six foot centers for 12 inch diameter pins, and in the lower end of each chain was a slotted hole, about four feet vertically by 12 inches wide: the function of this slot being to permit of a variation of up to two feet above or

girders; each girder had three holes, machined on two foot centers for the insertion of the 12 inch pins used to connect the chains with the girders. By pinning the upper girder to the chain and operating the hydraulic jacks by pressure the upper girder was forced vertically away from the lower girder, lifting the chains and the attached suspended span. The spacing of the holes



BRIDGE WITH SUSPENDED SPAN BEING LIFTED

below the normal height of the connecting pin in the stub links, which formed a part of the lifting girders attached to the span.

There was one jacking unit to lift each corner of the suspended span, each unit consisted of a steel plate girder which hung on stationary links from the extreme end of the main cantilever trusses. Above this girder, and free to slide vertically on trunks extending upwards from it, was mounted another girder, this one being movable. Between the two girders just mentioned two 1000 ton Watson-Stillman Hydraulic Jacks were mounted, one at each end. The two chains used for lifting each corner of the span worked vertically through suitable openings between the diaphragms of these two

in the girders on two foot centers, and in the chains on six foot centers, permitted lifting the span two feet, pinning the chains to the lower girder, removing the pins from the upper girder, lowering the jacks (and upper girder) two feet, again pinning the upper girder to the chains, taking the load on the jacks, removing the lower pins, again jacking up, etc., repeating this cycle simultaneously at all four corners of the bridge and regulating the speed of each jacking unit, and of each individual jack by a very ingenious system of telltales, and operating valves. Hydraulic power for operating the jacks was furnished by four 18"x2"x16" stroke single cylinder straight line steam pumps, operating by compressed air at 110 lbs. per square inch, instead of steam. Compressed

air was used instead of steam as it was more easily obtained, air having been used for the operation of riveters, etc., during the construction of the cantilevers, and compressors and piping were already installed. Three 534 cubic feet motor driven air compressors and two hydraulic pumps were used on each side of the bridge.

The pumps were connected and cross connected in such a way that two pumps could be used simultaneously on any desired combination of the four jacks composing two jacking units (the equipment of one cantilever), or either one of the pumps could be similarly used if necessary to shut off one pump; or one pump could be used for supplying one jacking unit while the other pump could supply the other jacking unit, each side working absolutely independent of the other, and if necessary at a different pressure: this condition could only arise from abnormal causes, such as a high wind pressure on one side of the span during the lifting period. The operating pressure used was 4000 pounds per square inch.

In order to prevent any damage, due to the sudden lowering of any one of the hydraulic jacks, in the possible event of failure of any part of the hydraulic equipment, two large screw jacks were built into and formed a part of each jacking unit, the screws were so counter-weighted as to enable one man easily to run the 12 inch diameter steel screws up or down by hand, and thus follow up the motion of the jack rams.

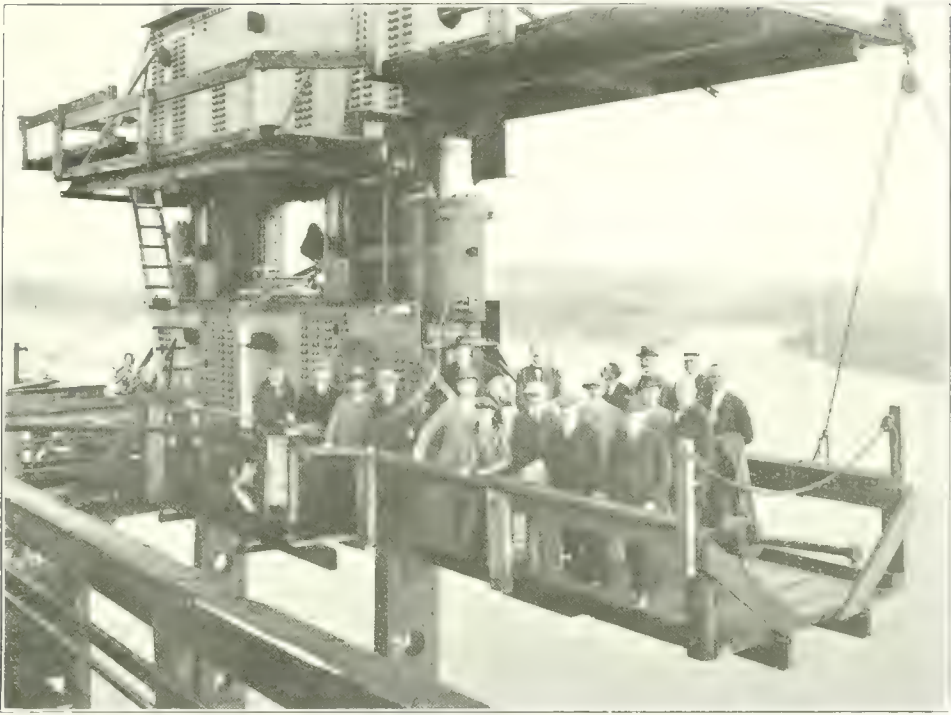
The lower ends of each pair of chains connected to a lifting girder under one corner of the suspended span, but the connection of each girder to the span was through a universal rocker joint composed of three steel castings and two cylindrical steel pins, placed one above the other and at right angles to

one another. The lower pin rested in one of the steel castings, which was bored semi-cylindrical to receive it; the upper pin supported a similar casting, in an inverted position, and the two pins were separated by a cruciform casting bored to fit both pins and to maintain their alignment on 90° axes.

A similar joint was interposed between the upper girder (from which the jacking units hung) and the end of the cantilever truss. These joints were installed to permit of flexibility. Any misalignment occurring during the lifting period could thus be compensated for without unduly stressing any member, either of the cantilever, span, or lifting equipment.

The entire lifting equipment, including the jacking girders, links, chains, hydraulic pumps, jacks and operating valves, and the universal joints just referred to were to be removed immediately after the span had been raised to the required height (about 140 feet from the elevation of flotation on the barges).

The actual operation of floating the span, and towing it to the bridge site, making it fast to the mooring trusses and securing it in the proper alignment, and attaching the lifting chains had been most carefully planned, even to the most minute detail: every tag line, cable or other piece of rigging was numbered and marked according to the sequence of events relative to its use; frequent drills had been conducted to familiarize the men with the equipment and with their various duties, until every man knew his station and his duties thoroughly; eight tug boats used to manipulate the floating span had rehearsed their part of the program. Everything humanely possible to anticipate to prevent a disaster, or even the slightest hitch in the proposed schedule, had been considered and provided for. The proof



JACKING GIRDER ON NORTH CANTILEVER

of the thoroughness of this preparation was amply demonstrated by the ease and precision with which the schedule, made weeks before, was followed on the morning of the day set for the moving and lifting of the span. Not a hitch of any kind occurred to mar the beauty of the wonderful spectacle. The various stages of floating, towing, mooring and attaching the span to the hoisting chains were all completed between the hours of 1 A.M. and 8 A.M., then a period of rest and refreshment was declared, to enable the men to get a hasty breakfast, and to allow the tide to recede sufficiently to gradually transfer the load of the suspended span from the six barges to the cantilevers, through the lifting equipment. Within less than one hour the three barges under the south end of the span floated clear and about two minutes later the three under

the north end followed. The cheering from the thousands of spectators, and the whistles from the excursion boats, tugs and small craft announced the fact that the hazardous part of the undertaking had been safely passed, and that the great cantilever and anchor arms were carrying their load with ease. The deflection of the cantilevers, due to the suspended weight was about nine inches, just what had been calculated and for which provision had been made in the construction. The danger period having passed, there was nothing more to do but to pump, slowly but persistently, until the suspended span was lifted, two feet at a time, until the permanent eye bars on the span could be constructed to the eye bars on the cantilevers. It was estimated that about sixteen hours actual lifting time would be consumed in the operation.

Several lifts had been made and the jacks were being lowered to make another lift, the span being held stationary at the time, when suddenly, without any warning whatever, something gave way, one failure followed another in such quick succession that the effect produced was simply a mighty roar of breaking, twisting and buckling members of the span as it tore itself loose from its supporting chains and girders and slipped down a distorted mass of wreckage, to be covered within a few seconds by the almost unruffled surface of the St. Lawrence River.

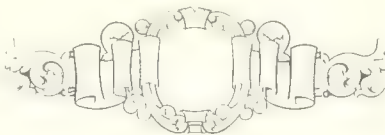
It was almost impossible to conceive of such a disaster, the confusion was intense, communication across the river was broken, and it was difficult to get an accounting of the number of men missing. This condition lasted but a very few minutes, for system and order were quickly restored; the men who were on the span and who were fortunate enough to escape were picked up by tugs and launches. A roll call later showed that twelve men were missing; a remarkably low fatality list for such a disaster.

Investigations were begun immediately and many of the most eminent structural engineers in this continent surveyed the evidence remaining, and

have since reported, unanimously, that the collapse was occasioned by the failure of the cruciform casting in the universal joint under the southwest corner of the span. This threw the weight of the span on diagonal corners; a condition of loading which threw such severe stresses in the lateral bracing of the span that distortion and failure of these members followed, allowing the span to buckle and wrench itself from its supports.

The cantilevers, anchor arms and all parts of the superstructure were subjected to stresses far in excess of their normal maximum loading, and stood the test without sign of failure or distress; a remarkable showing—a complete vindication of the judgment of the staff of engineers, whose foresight, courage and ability will soon have successfully executed a work long considered impossible.

The St. Lawrence Bridge Company has accepted the full responsibility for the disaster, and has begun the duplication of the lost span, altered only in minor details to prevent the recurrence of a similar disaster. The new span will be lifted into place probably during the summer of 1917, using the same method of lifting and using the identical equipment used for handling the first span.



THE HISTORY, DEVELOPMENT AND EXTENSION OF THE ELECTROMAGNETIC SPECTRUM

By H. P. HOLLNAGEL, PH.D.

Dept. of Physics, M. I. T.

Editor's Note. With this issue the "Technology Monthly Engineering Journal" starts a new series of articles on the Electromagnetic Spectrum. Dr. Hollnagel, by reason of his extensive and exhaustive investigations of the subject, is extremely well fitted to handle the subject and few could present it in a more interesting and, at the same time, instructive manner.

IN reviewing a field of such great interest it would be unwise not to glance hastily, at least, into the past in order that some meagre idea may be had of the rapidity with which scientific progress has been made.

The earliest indications of the development of a physical science Astronomy date from the time of the Chaldeans, who are credited with having been the first to record observations on celestial bodies (3800 B.C.). As the Chinese and Egyptian astrological determinations were made about 3000 B.C., it is reasonable to assume that the first-mentioned were their predecessors.

Profiting by the earlier experience of their neighbors the Greeks, associated with Thales of Miletus (about 600 B. C.), formulated ideas which rapidly crystallized into a tendency away from the earlier mythical beliefs that had dominated astrological observations. This tendency, together with the information contained in the records of their Babylonian precursors, and an abhorrence of things experimental, engendered an ardent desire to theorize as a result of which various schools of philosophy arose. Possibly the question occurred to one of their number, What is the agent that makes possible the observation of all things? and, it was but natural that the answers should be many and varied.

The scientific thought of Greece, during the five centuries B.C. had

centered about the teaching of Pythagoras, Empedocles, Plato, and Aristotle, each of whom had formulated a theory of the nature of light. Pythagoras, Empedocles, and Plato originated and supported corpuscular theories differing from one another only in the origin and effect of the light particles. Pythagoras, for example, maintained that sight was resultant on a stream of particles emanating from the body seen and entering the eye; Empedocles insisted that sight originated from a stream of particles leaving the eye; while Plato believed the agent was a complex form of two similar streams originating from both eye and object, and that their combined effect caused sight. By far the most important and advanced point of view was that of Aristotle who insisted that light is the result of an action in a medium whose activity is largely responsible for the production of sight. His reasoning, however capable, failed to supplant that of Plato whose teachings outlived him many centuries.

During these and succeeding centuries, civilization of the West fluctuated considerably both Greece and the Roman Empire had passed their zenith, and with their decadence the progress of science was, consequently, arrested but not extinguished. For in Alexandria Egyptian scholars continued to be engaged with their experiments in the transmission of light, and the

by this route the Arabians became, ultimately, the custodians of science for the interval. One of them—Al-hazen (? - 1038) refuted the theories of light of both Plato and Empedocles that had held sway through the Dark Ages, resurrecting that of Pythagoras.

Though it is true that the Arabs contributed but little in the way of original theory one must not lose sight of the fact that the impetus to scientific thought gained during the Renaissance (and which ultimately carried the search for scientific truth into Western Europe) might never have been possible without them: for the philosophers, who were active as late as the 16th century, preferred to construct optical instruments. Two notable exceptions to the foregoing class were—Snell, who discovered the law of refraction, and Descartes, who announced the first intimation of a wave theory. According to this new conception, light was a pressure transmitted by a medium of very high elasticity in a manner somewhat analogous to our modern idea of sound propagation. This theory never gained ground as its fallacy was proved by Fermat.

Passing to the last quarter of the 17th century, we find Sir Isaac Newton maintaining an emission theory that agrees, in great measure, with the Pythagorean theory. Newton became involved in an attempt to explain interference phenomena, which difficulty was explained away by Huyghens in 1690, who launched the first real wave theory of light, but who, in turn, found himself in a similar dilemma when attempting to explain polarization phenomena. Later, experiments by Young substantiated this theory and though it was specifically pointed out that his experiments were independent of any

particular wave theory, he in effect practically suggested a transverse wave motion at this time. However, the Newtonian idea held until the early part of the 19th century when Fresnel, in 1816, settled the mooted point by assuming the wave motion to be transverse instead of longitudinal. At once many minds interested in science attempted a theoretical explanation of the facts assuming such physical properties of the medium as would fulfill the optical requirements.

About the middle of the last century Green and Stokes propounded the elastic solid theory to which, for a time Lord Kelvin's support gave considerable weight. There have been many variations of this theory before and since that time which have met with minor success, but no really new development appeared until 1845 when Michael Faraday, son of a Yorkshire blacksmith, conceived and evolved a new idea. In his earlier researches he had been concerned with electric action in its relation to the surrounding medium, but now he actually tried to establish experimentally what he had previously believed possible, i.e., the effect of magnetism on the rotation of the plane of polarization of a polarized beam of light. In 1845 Faraday met with positive success. Twenty-five years later, Clerk Maxwell attracted by these researches solved analytically what Faraday had demonstrated experimentally.

This theoretician set himself the problem—What properties must a medium have in order to account for the propagation of electromagnetic phenomena as well as light?—knowing, with conditions given governing the latter, he had but to consider the former. By means of a very ingenious mathematical analysis, he concluded that electromagnetic waves will travel through this

medium with the same velocity as light. The necessary experimental verification was supplied by Heinrich Hertz, who, in 1889, demonstrated that electromagnetic radiations were identical in every respect with light and heat radiations.

Thus we have come to conceive of a possible composite nature of vibrations emitted by some electromagnetic source which by various means can be dispersed and separated into what we shall call the electromagnetic spectrum, obeying the same analytical laws as do light waves, at the same time including, as a very small portion of it, that which Sir Isaac Newton termed the spectrum.

It is conceivable that any electromagnetic wave is a displacement (electric and magnetic) propagated through a subtle medium with a constant velocity whenever electric forces are periodically changed at a point in that medium.

Furthermore, it is evident that the rate at which this intensity varies will fix the number of vibrations per second; consequently, an infinite number of frequencies is possible. There will be in a continuous electromagnetic spectrum an infinite number of waves varying in length from zero to an infinite value.

As Hertz pointed out, it is but necessary to have a suitable receiving device in order to detect various waves. (It is, however, equally important, as will be seen later, to have characteristic sources of radiation.) These receiving devices depend for their success primarily upon five effects that have been designated as electric, photographic, visual, heat-producing, and electromagnetic. Depending upon which of these is characteristic of the means of exploration of the spectrum, we may divide it into five classes.

Röntgen, Ultraviolet, Visible, Infra-Red Rays, Electric Waves.

THE next instalment of *The History, Development and Extension of the Electromagnetic Spectrum* of Dr. Hollnagel will appear in the December issue.

THE CALL FOR THE MAN WHO KNOWS

By WM. H. WALKER, Ph.D., Eng.D.

Professor of Chemical Engineering; in charge of the course in Chemical Engineering and
Director of the Research Laboratory of Applied Chemistry at the
Massachusetts Institute of Technology

Editor's Note. Each day some new opportunity is placed before Young America. Today, in particular, under the forced conditions due to the Great European Conflict, opportunities are more numerous than ever. The chemist plays no little part in the run of our every-day life, and under the stress of the war he is being forced ahead at an abnormal rate. His importance is emphasized by the thought of the utter helplessness each warring nation would be in without him, and the "call for the man who knows" echoes from shore to shore. Can America answer this call?

WHEN the European War broke out in August, 1914, each of the nations involved was met with problems which at first seemed almost beyond solution. The necessity of gathering together great numbers of able-bodied men and of equipping and training them into a modern army was at once recognized as a task of large dimensions. But there were those at hand who could perform this task. Even in England the standing army was able to supply in large numbers men capable of rendering the required service. However, an army notwithstanding its equipment and training, is powerless without munitions with which to serve its guns. Explosives of many kinds are demanded for every type of destructive agent from a hand grenade to a 42 centimeter mortar. But the manufacture of explosives is a chemical process and requires chemically trained men of ability in large numbers; and it was here that the Entente allies, especially England, found themselves wanting. Almost over night there arose an earnest and insistent demand for the man who knows how.

Chemistry as a science had existed in England for two centuries and more, and within her borders many famous men had contributed to its advancement. But neither the Government nor the people of England had given to her

chemist the station in life to which his importance in the community entitled him, nor had they encouraged in the slightest way the development of able men in the all important field of applied science. Oxford and Cambridge alone could stamp a man, notwithstanding an almost complete lack of knowledge of science and training in its applications, with a preparation which entitled him to serve the State. However important a knowledge of the ethics of ancient civilizations and the culture of Babylon may be to the education of a young Englishman, it was found to count but little when matched in battle with the lack of ethics and kultur of the modern German. When the emergency came there arose at once a cry for the man who knows.

It is only now, after more than two years of terrific fighting with its appalling loss of life, that the Allies are beginning to meet the demands for munitions which great armies in active service create. Germany, with her years of preparedness from every point of view, and her genius for applied science, has had the benefit of this period in which to conquer Belgium, overrun the Balkans and a large territory in Russia and to entrench herself on every side. She had, at the outbreak of the war, an ample supply of men who knew, both from theory and from practice, every

step in the preparation of the munition necessities of the German warfare. Necessity did not drive the Germans to invention with the inevitable loss of time which always accompanies the application of invention to practice. The necessities incident to blockade had been foreseen and the inventions already were made and in operation on a small but comprehensive scale long before the blockade was enforced. Thus there were men who knew what to do and how to do it in every line of industry and from every station in life.

But this effective preparedness for war was not reached by making munitions and other war necessities alone, or even in large part. Manufacturing industries had not been handicapped by a lack of market for their output in times of peace even though this output could be transformed into active munitions on short notice at the outbreak of war. Hence the great development in the products which come from the destructive distillation of coal. Other nations made coke, gas and ammonia and tar by distilling coal but were satisfied to stop with these products. But other nations used the coke for fuel alone; Germany carried hers to cyanamide then ammonia and then to nitric acid, a fertilizer in peace, a necessity for explosives in war. Other nations burned their gas as it came to them from the ovens; Germany took the benzol and toluol out of hers and made dyestuffs and other organic chemicals in peace, and made picric acid, T N T and other high explosives in war. And, also with the products of the distillation, were developed other products commercially profitable when on a peace footing, and invaluable when on a war basis.

For this far-reaching purpose Government aid and encouragement were furnished at every possible opportunity.

The Universities and Technical Schools of Germany co-operated with the Industries both through governmental channels, and independently, with an enthusiasm which made for success. Educational Institutions furnished men trained in applied science, and these men were recognized by the community as leaders in the development of the Nation; they held high positions in the Government, were officers in the Army and Navy and the technical directors of the great manufacturing and commercial industries. These were the men who knew.

What of America? From the point of view taken in the foregoing, we assume a position between England and Germany, but much nearer the former than the latter. The majority of our people still think of a chemist as a druggist's clerk, and utterly fail to appreciate the importance of the chemist to the community.

With the exception of agriculture the Government does nothing to our chemical manufacture and cannot be made to see the vital connection between a coal-tar chemical industry in times of peace and munitions in time of war. The present administration refuses a protective tariff which would enable such an industry, important though it is to the life of the Nation in times of war, to get securely planted in our midst. What the Government of Germany definitely and carefully provides in the way of co-operation between manufacturing concerns to insure economical production and a control of world markets, the U. S. Government definitely prohibits.

However, the United States is making rapid progress in the provision of those fundamental factors which make up preparedness, both industrial and military. The Government is making

new opportunities for scientific men even in old established industries which have until now remained in ignorance of the tremendous earning power of scientific control; of new industries founded upon the results of chemical research; of increased production in industries which, owing to European competition, have in the past struggled for our existence.

Especially is this true in the provision which is being made throughout the country for higher education in science and its applications. Research Laboratories manned by men trained in science and equipped with a knowledge of engineering are developing with a rapidity and solidarity which promises wonderful results for the future. A new plan for co-operative education and research which is far-reaching in its results has been put into operation by our Department of Chemistry. A five-year course in Chemical Engineering leading to an advanced degree has been provided for students of ability, and included therein is a School of Chemical Engineering Practice which is of exceptional educational value. A number

(at present fixed at five) of large and progressive chemical manufacturing companies representing widely differing fields of chemical engineering activity form the working plant of the new School. At each of the five plants the Institute maintains a well organized and equipped station for instruction and research. The Industry furnishes its plant as a working chemical engineering laboratory for instructional purposes, while the Institute furnishes the Industry with a research organization devoted exclusively to specific interests of the company. In this way real co-operation is attained; the factory experience involved will be invaluable to the students, while the great research resources of the Institute of Technology will be available to insure so far as possible, the solution of the manifold problems constantly arising in manufacturing. This wonderful opportunity to combine science in its most fundamental form with its immediate application cannot fail to produce men who in times of emergency will know what to do when there is something to be done.



ANNOUNCEMENT

We beg to announce the following action of the Board of Directors of this publication.

"Hereafter the publication formerly known in literary and engineering circles first as the 'Technology Monthly,' then as 'The Technology Monthly and Harvard Engineering Journal,' shall be known as the 'Technology Monthly Engineering Journal.'"

This action has been taken in order that the Alumni, Faculty, and Students of the Massachusetts Institute of Technology shall have a monthly publication devoted to undergraduate affairs at the Institute, and a journal of engineering literature—a magazine of Technology men and affairs.



THE FUTURE OF ROGERS

By JOHN RICHIE, JR.

Editor's Note: Technology moved to its new home on the Charles, amid the joyous celebration of thousands of its Alumni. Yet it was not without a sense of regret that Rogers was left behind, so to speak. This regret is overbalanced only by the fact that Technology still retains this old and notable building. Its memories and traditions will remain and be kept close to the hearts of the Alumni, for the building in which scores of the world's greatest men learned the lesson of devotion to their work of life and to their Institute is retained for continued instructional purposes.

VERY happy is the solution of the immediate future of the Rogers Building, as decided by the Architectural School of the Institute. This answers the question propounded the moment the plans for the new buildings were discussed, "What is to be done with Rogers?" The old building was characterized by Mr. James P. Munroe, in the formal farewell in June as "the Westminster Abbey for Technology," and reverential was the nature of the exercises on that famous Monday evening, when five thousand alumni gathered about its steps for the last time as the heart of the Institute.

About the old structure hangs a wealth of interesting history and tradition. Its corner-stone was laid by William Barton Rogers when he had only fifteen students in his school. He had the courage of his convictions that the time was ripe for the introduction of a new method of educating, which in his own words was "to teach young men by making them do things." The Rogers Building was the place in which this experiment was tried; it has seen the gradual up-growth of vocational training, in these days extended to the elementary schools; and within its walls were established the beginnings in this section, modest indeed they were, of the great laboratory system which today

dominates technical education. It has been the starting point from the east side of the river to the Institute's main engineering school, hidden under a stairway, to the vast structures by the Charles where the idea has attained the greatest development known to the world today. Within the Rogers Building there were developed what were pioneer technical schools of the country, whose graduates have carried on the good work at the heads of other schools teaching in the same natural manner. Thus the Rogers Building was the starting place in New England of the greatest educational movement of modern times, and Boston was deliberately chosen by Professor Rogers because it seemed to him the most suitable environment for such a development. The Rogers Building, therefore, as a monument to the founder of the Institute, has its interest not only to M. I. T. alumni, but to Massachusetts, New England and the country at large, as the cradle of the laboratory method.

To the alumni of the Institute the interest is the more keen, for to ten thousand former graduates scattered all over the world Rogers means the center of the educational activities of their alma mater and to half that number, it is the only Institute they ever knew. Little wonder, therefore, that

deep interest was felt as to its future. This found expression in various ways, one of which was the suggestion that it be taken down, brick by brick, moved to Cambridge, and set up again in some prominent place within the Institute's holdings. Some of the earlier drawings, indeed, show it placed on the Riverway, about where the dormitories are now located.

Meanwhile there were other forces at work which induced changes in the original plans. When the first pile was driven, it was the intention of the Corporation to build a temple of learning which should house all the educational activities of the Institute. Since that day in 1913 there have been important changes in financial conditions in this country. The first of these was stringency and a depression in real estate. When the matter was taken up it was obviously not an opportune time at which to dispose of such holdings, and this kind of property constituted a considerable portion of Technology's resources with which to build. President MacLaurin was willing to go no farther than the way was absolutely clear. He therefore revised the plans, left out portions of the proposed constructions and rearranged to an extent the disposition of the departments within the wings of the new buildings.

Till that moment Architecture had been given the two wings on Massachusetts Avenue and the Esplanade now occupied by Civil Engineering, while Mechanical Engineering was to have occupied wings still unbuilt extending in two directions from the present northwestern corner of the group. It was hoped to make of the architectural buildings an especial construction, differing essentially from the uniform plan which has been followed out in the other departments. There were hints of a

splendid two-story foyer and other specialties, which, being fundamental, would require their own plannings from the beginning, constructions now out of the question in the buildings that are finished.

When the changes were determined upon, it was evident that some of the departments could not be housed in Cambridge and the selection was made, Architecture and Mining and Metallurgy. The former is of all the courses the least tied in to the general run of engineering studies, the one which being of the arts could best be separated from the rest, while Mining has had for many years its home in the basement of Rogers. Thus it is that the School of Architecture will continue for a while on Boylston Street.

Since the change in plans Mining has found support at the hands of generous alumni so that a Mining wing is structurally complete and will be occupied in a month or two, and when this is effected and the removal completed, Architecture will have all the resources of Rogers to itself. And in this there is a certain fitness.

In the early years of Technology the upper floor of Rogers, the only Institute building, was ample for the needs of Architecture. There it had its beginnings and from its drawing rooms went forth a line of architects, Cass Gilbert among them, who laid the foundations for the Institute's reputation as teacher of this profession. As Technology grew, and Walker and the buildings on Trinity Place were added, Architecture was transferred to the Pierce Building with a healthful ascent of stairs to its drawing rooms and library. It now returns to its original home, but demanding the whole building, testifying to the growth which this department, in common with the

others, has experienced in the past half-century.

The new arrangement of Rogers, which is in effect a return to the great drawing rooms and spacious halls of the original layout, is remarkably well adapted to the needs of instruction in architecture. Those familiar with the building these later years will know it best, perhaps as a bee-hive of industry with the workers in individual cells. The cubicles which were necessary to the administration uses of the building have been swept away and partitions of a quarter of a century's use are gone. To him who knew the original Rogers, the change is refreshing, and the great rooms are in keeping with the dignity of the structure.

The old reading room on the entrance floor has become an exhibition hall, and will supply a need of the community. There has been till now in Boston, no place in which the exhibitions of architectural societies could be given, save in a rented hall or by invading the apartments of a clubhouse. Today Technology supplies the need and besides furnishing a place suitable for the hanging of the work of its own student, bring into closer touch with itself the society of the city, an influence that will be enormously beneficial to the student and to the department. Every effort has been made in this department to keep abreast of the times, and to this end there are always in the faculty practising architects of the highest character, and the new public spirited action in furnishing a meeting and showing place for the whole local profession cannot fail to react on Technology.

Huntington Hall will remain what it has been for many years, the forum of intellectual Boston; here the Lowell Lectures continue and the meetings of

many scientific, literary, and artistic societies. The Lowell Institute will retain an office on the first floor, and here there will be a Museum of Technology, a placing in permanent form of the great collection of historical material that was assembled in Cambridge in June.

On the second floor will be the offices of the instructing staff, those of the professors having vistas of the street through the great stone pillars of the front. Professor Gardner will be established a flight higher, at the observation point long occupied by the News Service, while the old Alumni Office, the class room (32) and the intervening offices have been thrown into a magnificent single library room, the whole width of the front, and the adjoining class rooms 33 and 36 are for the fine arts collection and the reading room respectively. This will ensure a housing of the library and continuing to its availability that were not possible in Trinity Place. Then above, occupying two floors, one of which was the original evrie in which Tech architectural spirit was fostered, are the drawing rooms, which today impress one with their size and the excellent quality of their lighting.

So it is that today the School of Architecture of the Massachusetts Institute of Technology finds itself homed in a building perfectly adapted to need, who extend to the people the nature of the work within. The Institute has been from the beginning a disciple in the country of the Ecole des Beaux Arts of Paris. The teaching of the great French ateliers have been the ideal of the American instruction, and the faculty has been imbued with their spirit while men like Despradelle have been the direct links between the In-

stitute and the Beaux Arts. And the Rogers Building is itself a fine example of the earliest influence exerted in this country by the famous French school, a structure truly noble and dignified, which cannot fail to have stimulating influence on the students who gather within its halls.



WOOD PULP USED IN PAPER MANUFACTURE

By W. P. RICHARDSON
Cornell University

Editor's Note. For a number of years Mr. Richardson has been actively interested in chemistry of many different types. At present he is acting in the capacity of Head Chemist for the Cornell Wood Products Company of Cornell, Wisconsin, the makers of the well-known Cornell Wall Board. His experience with this company and that with other paper and pulp mills in the country makes him especially fit to write on the subject of wood pulp and its manufacture.

Paper enters into the life of every person every day and it is highly desirable that everyone have at least some idea of a few of the processes it goes through before it is placed on the market and reaches the consumer. The following is a simple and instructive summary of the four common processes of the manufacture of wood pulp.

PAPER, when examined closely, is found to be made up of individual fibers, sized to make ink-proof, and then closely fitted together. With the fibers which form the sheet may also be found clay or talc used as fillers, or the sheet may be coated with blanc fixe or satin white, or some other material used to obtain certain desired finishes. Here, however, we are interested only in these fibers, the main constituent of the paper, and will discuss only the conversion of the wood to the pulp.

There are four different processes commonly used in the manufacture of wood pulp, one mechanical, known as the ground wood process, and three chemical: the sulphite, soda, and sulphate processes.

Mechanical Process

In the mechanical or ground wood process the logs, upon their arrival at the mill, are sawed into two-foot lengths. These short pieces are then conveyed to the barker room where the bark is removed by placing the log against a rapidly revolving disc containing knives. From the barker room they pass on to the grinder room. The grinder consists of a large grindstone mounted vertically and encased in a cast iron covering. Arranged in this casing or covering are a number of pockets in which the barked wood is placed crossways to the direc-

tion of the revolving stone. Pistons operating within the pocket, by hydraulic pressure, press the wood against the revolving stone. Water is continually supplied to wash away the fiber that is ground from the blocks of wood and the fiber is then passed through screens where the slivers and coarse material are removed. These screened fibers, or pulp, as we may now call them, are ready to be made into paper.

The pulp made by this grinding process is short fibered. In grinding, the fibers are broken off and not isolated as in the chemical processes and the pulp retains much of the resinous material of the wood from which it is made.

It is generally necessary that some chemical pulp be added to this paper in order to obtain a good sheet, for paper made from ground pulp alone are not at all durable and have very little strength. News print paper is generally made up of approximately 80% ground wood fiber and 20% sulphite fiber.

Sulphite Process

In the manufacture of wood pulp by the sulphite process the method of preparing the wood is the same as in the ground wood process. Instead of using the two-foot lengths after the wood is cleaned, it is reduced to chips. These

chips are screened to take out slivers and knots and then conveyed to the storage bins over the digesters.

The digesters vary in size, an average sized digester being approximately fourteen feet in diameter and forty feet in height. It is made of iron and heavily lined with acid-proof brick. All fittings are of lead and bronze in order to resist the strong corrosive action of the cooking acid.

There are three methods of making the cooking acid: tower, continuous, and dumping systems. Sulphur is burned, the gas is cooled and absorbed by water. The acid formed reacts with the limestone in the tower system, or the milk of lime in the continuous and dumping systems to form a weak bisulphite of lime solution containing a certain percentage of sulphur gas, not in combination.

The acid liquor and the chips are introduced into the digester and then cooked with steam at sixty-five to seventy-five pounds pressure for eight to fourteen hours, the time and pressure varying with the practice at different mills. When the chips are sufficiently cooked, a valve at the bottom of the digester is opened and the contents of the digester are blown into a large tank. This tank, known as a "blow pit," has a false bottom, through which passes the waste liquor containing the resinous and ligneous material from the wood.

The chips are thoroughly softened by the cooking process and the violent discharge into the blow pit breaks them down into the individual fibers. After washing and screening to remove the acid and any undigested slivers, knots, or bark, the pulp is ready for the paper mill.

A great quantity of sulphite pulp, generally in combination with some of the other pulps, is made up into wrap-

ping, bag, or tissue paper. Often it is bleached and used for book or writing paper, and some of our bond papers are known as wood bonds and are made from sulphite fibre.

Soda Process

The soda process for making wood pulp is an alkaline process, the direct opposite of the sulphite, or acid process. When originally started, the woods used were almost entirely poplar and cottonwood or other trees of that family. Now considerable spruce and other coniferous trees are used. The preparation of the wood for cooking is the same as that followed in the sulphite process. After the chips are prepared they are introduced into a digester with a caustic soda liquor, where they are cooked with steam at ninety to one hundred and twenty-five pounds pressure for six to ten hours. When the cooking is finished the digester is "blown" and the liquor allowed to drain from the "blow pit." The pulp is washed thoroughly and screened and is then ready to be made up into paper. Soda pulp is very soft and generally after being bleached it is used in book and writing papers.

The liquor in the soda process which drains from the blow pit is saved, evaporated down to a thick black liquor, and burned to destroy the organic matter. Soda ash, the product left, is causticized and is then ready to be used for further cooking.

Sulphate Process

The sulphate process by which the so-called "Kraft papers" are made is a modification of the soda process. The preparation of the wood is similar to that of the sulphite and soda processes, although as much care is not necessary in the selection and cleaning of the wood. In addition to the caustic soda

used in making the liquor as in the soda process, although slightly modified. Practically the same procedure is followed in the coloring in both processes. The pulp is very soft and strong and is used particularly in wrapping paper, or papers where strength is more essential than color.

Each of these wood pulps, the manufacture of which has been very briefly outlined, serves its special purpose and one is really as valuable as the other.

Although their relative market values are different. Many improvements, both in procedure and product, have been suggested and some proposed. In the manufacture of wood pulp there is a big field for further improvement in the perfection of the present process and also in the utilization of new raw materials from our forests in the South and West, upon which forests we will shortly be dependent for our supply of woods for wood pulp.



THE CONSERVATION AND PROTECTION OF OUR BIRDS

By A. E. TUTTLE, M. I. T., '17

Editor's Note. There are at Technology a great number of men interested in gunning. Technology stands for advancement, advancement along every line, engineering, hunting, or what not, and it is gratifying to note that the true Technology sportsman is back of all of the wise measures which have been passed and are being passed for the proper regulation of the hunting of our feathered friends. The following article deals with some of the laws and conditions now existing concerning our birds.

THE importance of bird life as a factor of our existence has resulted in the passage of many wise laws, by various classes of men according to their special interests, for its protection and propagation. The value of the feathered tribe is based upon their flesh as food and their ability to protect crops through their insectivorous appetite or fondness for vermin.

A few years ago song birds, such as robins, blackbirds, and bobolinks, were slaughtered by the thousands in Texas to be served at the hotels under the name of reed birds. As a result of this the cotton boll-weevil, which, unrestricted, multiply very rapidly, practically destroyed the cotton crop with a loss to the state of millions of dollars. The economical entomologists or ornithologists, I am not prepared to say which, suggested that the protection of insectivorous birds might be a solution to the problem.

Laws were passed which remedied this, and with the increase of bird life, the boll-weevil was practically exterminated. So fully was the importance of the birds appreciated that today Texas has most stringent laws, unexcelled by any other state, protecting its bird life.

Another class of birds, the hawks and owls, which were from an economic standpoint even less appreciated than the song birds, suffered the death penalty by the hundreds for the vicious acts of a

few. Some states passed laws placing a bounty on the birds because they bore an unjust reputation as a class that robbed hen coops. The killing of hundreds of birds followed, without regard to their habits or value, with the results that in a comparatively short time these states were overrun with mice and other vermin. Due to the economic losses that resulted, an investigation of the habits of hawks and owls was made, and it was found that in the majority of cases these birds, with the exception of the little sharpshinned and cooper hawks do more good than harm.

Since the two classes of birds that I have just touched upon have no special food value and are entirely out of the game bird class it has been a simple matter to pass laws protecting them at all times from destruction by man. They are at present well protected, their value to crops is fully estimated, and their only human enemy is an occasional foreigner who attempts to evade the law in order to appease an epicurean taste more catlike than human.

Owing to the various interests at stake, often clashing with each other, it has been a more difficult matter to form and pass laws for the protection of game birds. The source of most of the difficulties has been a lack of comprehensive knowledge of the value of protection, the common ignorance of the habits of birds in relation to their propagation, and the wide range of territory that some



Courtesy of M. L. Fishel and Capt. C. M. C. C. C.

Our alien foreign-born citizens are adepts at snaring birds in violation to the law. Horschair nooses are effective and are difficult to detect until they have done their work.

birds occupy from one breeding time to another.

Legislation in this line has been confined entirely to the States until recently when the United States Government passed a law controlling the shooting of migratory birds. Although this law is one of the most important measures yet taken for the conservation of our game birds, there has been a movement through the greater part of the United States, especially in the west, to enforce the recall of this law.

Associated with the passing of law is their execution. This is the duty of a special body, the fish and game commission. When first established in this state its duties were confined to the protection of game, but now its functions have increased until it is not only a police department and warden-

ship to prevent infringement of the law, but also a scientific body for the study and advancement of fish and game. The wardenship has practical difficulties in the way of execution because it is impossible to police a state properly without a greater number of wardens than the cost warrants. Because the sportsmen themselves, for the most part, they have created, have framed most of the laws, a few do much to help their execution and a sense of honor prevents the great majority from infringing.

The open season on migratory birds for shooting upland game birds lasts one month, beginning about the middle of October. It opens on a holiday so that the workman, who might not wish to miss a day for shooting, can have a fair chance with the weather conditions. The state warden is responsible for the

best average time for all the game birds. Sportsmen who hunt quail and partridge would prefer a later season when the leaves are gone, but a later season would exclude a greater part of the woodcock shooting. A universal season for all upland birds offers the advantage of better protection to the birds and is more economical to the state, since at that time extra wardens are usually employed. The laws regulating the shooting of upland game birds apparently are giving general satisfaction, for very little controversy has arisen on this subject for several years. It is my personal opinion and that of my acquaintances however that partridge and quail are becoming very scarce in the eastern part of the state.

Another class of game birds that has caused more discussion and disagreement, in regard to an open hunting season, than all others is that group composed of ducks, geese, and brant. Although the passing of laws protecting this class met with great opposition, the result of these laws is beyond question. Even those who were most bitterly opposed to the measures admit their efficacy, and some assert, although not much stock is taken in it, that the black duck has increased to such an extent that the supply of natural food is hardly sufficient to take care of them. Such an exaggerated assertion is evidently advanced so that the law on other species may be modified or rescinded. Through the late winter and early months of spring the black ducks mingle with the thousands of Scoter and Shelldrake which occupy our coast. For the reason, that if shooting is allowed at this time when the black ducks begin to mate, they will be driven out of the country, a law was passed in Massachusetts several years ago stopping all spring shooting of ducks.

The result has been that the black ducks are again breeding extensively in this state and their number has greatly increased. Consequently the migratory ducks have also increased and any danger that there may have been of their extermination is removed. Without question there is a sufficient number of Scoter and Shelldrake to admit a limited amount of spring shooting, but owing to the effect that it might have upon the black ducks the law is still under discussion.

The national law affecting migratory birds exercises a rational control of the shooting of snipe and the remaining types of game birds. These birds have suffered much from the hunter and many species are now exterminated.

Two noted sets of laws now enforced in this state do much toward conserving the life of our birds: the prevention of sale or exportation and the regulation of the bag limit. The effect of these laws is the riddance of the pot hunters, a group of men who made a business of killing and selling game during the hunting season. The skill which these men attained in the art of decoying and shooting enabled them to take a great many birds during the season.

Another factor which has done a great deal in preserving the birds is the establishment of sanctuaries. A sanctuary is a place reserved for birds and wild life where all shooting is absolutely prohibited. The birds soon locate these places and live there in peace. If they are hard pressed by the hunter when outside the sanctuary they will often take refuge there. In these places they become very tame and in many instances their habits resemble those of domestic fowl. All state properties utilized for special purposes are now used for sanctuaries, and also private parties have turned over large areas of natural



Courtesy of Alaska Fish and Game Commission

Bobwhite or Quail is the "family circle." The characteristic position of the flock when at rest.

cover for this purpose. In a way the property is leased to the state and the game commission takes care of the protection of the game there.

The increased interest taken by the public in bird life in the last few years

means that more game birds are killed the winter hundred or so per cent the limit in the north and the south may make their life more comfortable and increase their numbers.



THE SECOND NATIONAL EXPOSITION OF CHEMICAL INDUSTRIES

By RATLEF K. MELTONY

Editor's Note. When the German artillery commenced the destruction of the "impregnable" Liege forts, the then economic world-balance was destroyed.

The recent Second National Exposition of Chemical Industries marks a new war,—a trade war in which the firing lines will be drawn after the present war is over, and in which America will play a hitherto undreamed of importance.

The following article gives a Tech man's impressions of this epoch-marking exhibit.

REALLY I was right proud to be an American Chemist as I walked through the Second National Exposition of Chemical Industries at the Grand Central Palace in New York during the last week of September.

Back in the early days of 1914 such a thing in the United States was only dreamed of,—yes, it would come, some day, but *when* was a question. Do you think it is true that the Great War offers, as it were—balancing world conditions, as much happiness as sorrow (disguised though it be), or as much glory as tragedy? If so, then our wonderful national development in our Chemical Industries makes up in great part for much of the tragic sorrow that, only too often, our own blood is suffering on one or the other of the European firing lines.

Technology may well be proud of the part that her chemical sons have played in, as it were, this nationalizing of America. They were there in abundance,—both faculty and alumni—they took a very prominent part in the meetings and discussions, in the addresses, and in many and many an exhibit, you would have recognized that Tech men were "the power behind the throne," had you known the Alumni Register as well as I do.

There were exhibits by one hundred and sixty-six corporations, nine socie-

ties and publications, and five important Government Bureaus.

The Exhibition opened on Monday afternoon, although things were not in full swing until a day or two later. The American Chemical Society really inaugurated activities when it met on Tuesday morning. From then on, every morning and afternoon, meetings of conferences were held. Our neighbor, Columbia University, was very courteous in opening her buildings and lecture rooms to the Nation's chemists. The Chemists Club of New York was very considerate in doing the same thing.

The American Electro Chemical Society met Thursday and Friday, where its discussions were necessarily more limited to the electrical phase than to the larger, and more general, American Chemical Society meetings.

It is interesting to note that the American Chemical Society has above 8000 members, being the largest and most active chemical society in the world.

The social side was by no means neglected by these modern magicians. It was one of the ambitions of the two great Societies, which made the Exposition the brilliant success that it proved to be, to have as much of the fairer, or feminine phase of the system there as possible. A special Ladies'

Committee, composed of the wives of some of our great chemists, took especial care of this side of things. Wednesday they took an auto trip up the beautiful Hudson River. Thursday they indulged in their favorite indoor sport—a shopping tour in some of the world's largest and finest "shops." That evening they were given a complimentary theatre party. This was repeated Thursday night, with great success on Friday afternoon, and that evening at the great Banquet their presence made us realize that after all, chemistry is by no means the most important part of a chemist's life. Saturday the culmination and height of enlightenment due to their presence was reached in an all-day Boat Excursion given by the American Electrochemical Society.

There was abundant opportunity for the men to get together at the various receptions and smokers, not to mention the conferences. Tuesday evening the American Chemical Society gave a reception to the members of the American Electrochemical Society, while this latter organization gave a smoker to the Chemical Society the following evening. Friday evening was the time of the Banquet at the Waldorf-Astoria, given by the Chemists, and which the Electrochemists were invited to attend, while the "Electros" gave the Boat Trip up the Hudson on Saturday, which many Chemists attended. Don't you wish that you had had the opportunity of attending? It was really well worth while if only to get the inspiration that the minds of Master Men give out on such occasions.

Most of the American Chemical Society meetings were held by Divisions, due to the diversity of interests. The Society is divided into the following sections: Biological Chemistry; Agri-

cultural and Food Chemistry; Inorganic Chemists and Chemical Engineers; Pharmaceutical Chemistry; Organic Chemistry; Rubber Section; Physical and Inorganic Chemistry; Water, Sewage and Sanitation; and Fertilizer Chemistry. In each section many interesting papers were presented, which were followed by numerous discussions.

In the 323 exhibit booths were all kinds and sizes of apparatus. For Balfour, for instance, the Model C exhibited 72,000,000 gallons of machinery, in forms such as nitrators, concentrators, and so forth, some 10 feet in height, and as large in floor dimensions. An ultramicroscope showed the vibrations of colloidal particles so small that it would take 1800 of them to make a body as large as a red blood corpuscle.

It might interest our autoists to know that chemistry is not neglecting their theme of interest. A. D. Little, said: "There is no longer any question of commercial success in the manufacture of alcohol for automobiles. Experiments have shown that alcohol can be manufactured for as low as twenty-five cents a gallon, and at that price it will undoubtedly be preferable to gasoline. Alcohol is cleaner, it will not as readily catch fire and will develop nearly as much horsepower." He further said that in the yellow pine district enough material is wasted to make 600,000 gallons a day.

Popular as well as scientific opinion will perhaps always associate our recent advances with our mastery of the dyestuff situation. From an almost complete dependence on the Kaiser's Empire for these materials prior to August 1, 1914, we have been threatened famine to the extent that we are now manufacturing seventy-five per cent of our annual requirements prior to the war, which was 29,000 tons

for 1913. These figures were given by Dr. T. H. Norton, Commercial agent of the Bureau of Foreign and Domestic Commerce, who also predicted that at the present rate of increase, our supply would soon equal one hundred per cent of our former consumption. There were exhibits by manufacturers of intermediates, such as benzol, toluol, nitrobenzol, aniline, etc., as well as exhibits by the manufacturers of the finished dyes.



TECHNOLOGY MONTHLY ENGINEERING JOURNAL COVER COMPETITION

ANNOUNCEMENT

During the course of the year The Technology Monthly Engineering Journal will run a series of competitions. The first competition will be open to all students of the Massachusetts Institute of Technology under the conditions and regulations printed with each competition.

COVER COMPETITION

A prize of a paid-up subscription for a period of four years will be awarded the person submitting the best original cover design for The Technology Monthly Engineering Journal.

A second prize of a paid-up subscription for a period of two years will be awarded the person submitting the second best original cover design.

This competition is open to all students registered in the Institute, regular or special, and regardless of class.

The required drawing is to be a line drawing in black and white on a sheet the proportions of which are to be as $7\frac{3}{4}$ is to $10\frac{1}{2}$. The best size will probably be at least twice these dimensions. The only lettering to appear on the cover will read as follows: THE TECHNOLOGY MONTHLY ENGINEERING JOURNAL.

The contest will close at 5 o'clock on Friday, the 8th of December. Designs must be submitted at the Publication Offices of the Magazine.

The jury will be made up from members of the Faculty, and the winning cover will appear on the January issue.

Further information may be obtained by addressing the COMPETITION EDITOR, THE TECHNOLOGY MONTHLY ENGINEERING JOURNAL, Massachusetts Institute of Technology, Cambridge, Mass.

EDITORIAL SECTION

The Technology Monthly Engineering Journal

A MAGAZINE DEVOTED TO THE INTERESTS OF THE MASS.
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All Positions are open to competition.

All manuscripts submitted for publication in the TECHNOLOGY MONTHLY ENGINEERING JOURNAL should be accompanied by the writer's full name and address. Manuscripts not accepted for publication will be returned only if the author so requests. Photographs, drawings, etc., will be returned to the contributor immediately after publication.

Forms close the 28th of the month immediately preceding date of publication. Material specially arranged for may be received up to the fifth day following.

EDITORIAL

FRESHMEN ATTENTION!

FRESHMEN, an editorial is coming to you—no, the great Freshmen—so attention, please, and absorb our brief message of wisdom: you have registered as student at Technology, one of the finest, we believe, of the best, institutions of its kind on this little planet of ours, and you have heard many things, true and otherwise, of the 'Stute. You have heard of the terrific amount of work Tech students consume, and overmodest grads may have told you of fabulous bills accruing from excess burning of the midnight gas jet. Now while we hate to discredit these stories, in fact might not be able to discredit them, we can assure you that Tech men are not required to accomplish impossibilities, that our professors are not fire-eating, student-devouring ogres, and that the classroom is far from including the whole of Tech life. The man of you who today leaves the Institute behind him when he has finished with his classroom assignment is failing not only to obtain the greatest enjoyment that can be obtained from a Tech career, but is closing to himself an opportunity which he can find no place else. The most valuable elements of a college education are not necessarily those for which one pays tuition, and in the final analysis, the man who, while granting full time to the demands of classroom work, goes out for the undergraduate activities, and gets acquainted with the men who are "doing things" in the Institute, is the man who, when he graduates, will reap the full benefit of the time he spends here. We say this not only because it is our personal belief, but because it has even been whispered that the faculty no longer look askance at student activities, that some of them even encourage participation in such a course. We take the liberty of quoting the words of a professor at the head of one of the departments: "When we write letters of introduction for former students their classroom records are not the only things taken into account. In fact, we may not take those into account at all. We try to gage a man's fitness for a post by everything we know of his actions and activities at the Institute." Take this to heart, Freshmen. Now is the time to come out for jobs. Next year is too late. Come down to the Coups in the basement—rooms 1 075—and get something to do. Remember—studies first. But next, the development of the broad man, the man of the world, the man who does big things. That is the course of instruction waiting for you in 1 075.

MORE HASTE, LESS SPEED

THERE is apt to be too much haste among the young college graduates to get out of school, away from the old ways of living and old companions, into the big industries. The tendency seems to be for young college men to anticipate too much, to expect to be given vast responsibilities before having undergone the routine development and training needed by the "big" engineer.

This spirit of unrest among the younger men is perhaps more noticeable now because of the great impetus given to our American manufacturing by the European war. The excitement that invariably accompanies a period of great financial and industrial prosperity is naturally contagious to the college man with his mind alert and his senses keenly sharpened by constant mental exertion. But along with this alertness is a feeling of discontent which is harmful in itself. The young college man sees others doing what he himself would like to do. He reads about the wonderful engineering feats that have been accomplished while the industrial world is duplicating the results and even improving upon these wonders. He feels a perfectly natural unrest because he is obliged to sit idly by and watch—he imagines that he is, to use a popular phrase, on the outside looking in. But upon a sane consideration of the question we find a peculiarly optimistic outlook for the man who finishes his course.

This period of industrial prosperity has manifested itself in a demand for American made goods. The industries of this country have suddenly found themselves demanding an immediate supply of plant superintendents, chemists, construction men and foremen. It was unwise to consider promoting the unskilled laborers, since they too are needed. So the manufacturers choose to install a small army of young college men—some graduates, but in some cases even unfinished boys in the midst of their education. They have taken these men and put them in charge of the various plant operations. The result is that we find in the industries a class of men wholly untrained except in their one line, entirely unfamiliar with the fundamentals of manufacturing and scientific work, unfinished, and partially untrained. True they have fairly good jobs,—for the present that is enough,—but they have very little to look forward to when the war is over.

Very few people are capable of predicting the outcome of the present struggle. We might even imagine this vast army of partially trained men going back to college—beginning over, or perhaps starting in where they left off. It may be that the men now in minor positions in the industry will have found time to train themselves sufficiently for the period following the war. At any rate, it is certain that whereas the demand for technically trained men is great now, after the war it will be still greater. The best men will be in demand, and there will be no place for the half-baked, partially trained men. Industries reorganized on a peace-time basis will demand high-grade men—men capable of reconstructing on a sane commercial basis what the inexperienced engineers, constructed hurriedly and poorly. The demand will be for men who have kept to their training—who have been in school during the war—who have been less feverish, but more consistent—less eager to get rich quick, but more stable and conservative.

A TRADITION LABORATORY

NEW building, new location, new sentiment, new enthusiasm, new devotion, valued veterans, old friends, anxious friends, friends of the future, the passing of the old order, the coming of the new. We are to the editorial writer. What a harvest of opportunity for platitudes, adjurations, platitudinous homilies. We really should revel in this wealth of material.

But remember. In this work we are entering a terra incognita, we are treading blindly, without direction. It is to remedy this that we need action. We have here all sorts of opportunities, we have presented to use a real college campus, a great asset in the building up and keeping alive of the life pulse of a college. Now is the time for constructive work. Now is the time for intelligent and conscious action on the part of all Technology organizations to originate and perpetuate those customs, symbolic or otherwise, which shall have for future classes real significance, value, and inspiration. Now is the time!

It will be of interest to note the advantages that are being placed before the students of various Colleges and Universities throughout the country through the addresses of Dr. Percival Lowell. The following is the notice of the itinerary of his latest lecture tour:

"Percival Lowell, A.B., LL.D., Director of The Lowell Observatory, Flagstaff, Arizona (and non-resident Professor of Astronomy, M. I. T.), leaves Boston, September 27, for an extensive astronomical lecture trip. Dr. Lowell will speak before The State College of Washington, University of Washington, Reed College, Oregon Agricultural College, University of Oregon, Leland Stanford Junior University and University of California. Dr. Lowell will also address the Harvard Clubs of Spokane and Seattle and deliver two extension course lectures under the auspices of Reed College, in Portland, Oregon. The subjects of Dr. Lowell's lectures are:

"Mars Forecasts and Fulfillments.

"Great Discoveries and Their Reception.

"The Far Horizon of Science.

"Before returning to Boston Dr. Lowell will spend some time at his observatory in Flagstaff."

HARVARD ENGINEERING SOCIETY OF NEW YORK

A most enjoyable afternoon visit to the Hell Gate and other East River bridges of the New York Connecting Railroad preceded the first regular meeting of the season, September 30, of the Harvard Engineering Society of New York. Thirty-nine made the trip. The meeting, at which forty-eight members and guests were present, was held in the evening at the Harvard Club. Mr. H. W. Hudson, engineer in charge of the construction work visited in the afternoon, gave a very interesting illustrated talk on the work. He was followed by equally interesting remarks by Mr. W. B. Updegraff, member of the society, who

was on one of the cantilever arms of the Quebec Bridge when the suspended span fell.

The annual field day of the society took place May 27 at the Short Hills Club, Short Hills, N. J. The rainy weather that dogs these field days did not dampen the spirits of the thirty who braved the elements. All agreed that it was the society's best field day.

The officers of the society for the year, elected at the annual meeting April 21, are as follows: President, Charles Gilman; vice-president, Warren Delano; secretary, Clifford M. Holland; treasurer, Thomas C. Desmond.

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Clerk (country inn): I'd lose my job if I told you! It means money to us to keep you here!—Boston Globe.

DANGER FOR SOMEONE

First Stoker (weary): I'd like to find the merchant 'oo invented boilers.

Second Stoker (also weary): Boilers be blowed! I'm lookin' for the blighter 'oo found out that coal would burn.—Punch.



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other patterns, either standard or extra
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LOOKED FORWARD TO

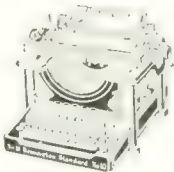
She: I'd known you'd be such a
brute to poor Ed. I'd never have
married you.

He: The anticipated pleasure of hav-
ing that adorable little beast was one
of my chief reasons for proposing.
Stray Stories.

THANKS!

Mother: Looking through my paper.
Darling, I see from this column
here that every time, fate has sent
me a little closer.

Father: Looking in the paper. I just
thank goodness this is not the New
York Globe.



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BETTER

"Hearing those high-priced opera singers on the phonograph is almost as good as hearing them on the stage."

"Better. You can shut them off whenever you like on the phonograph."

—Musical America.

MISNOMER

She: I hear that you skated into an air-hole the other day.

He: That's what they call it, but I found it full of water.—Boston Transcript.

TIME TO CALL ONE NOW

"Mother, is it true that an apple a day keeps the doctor away?"

"Yes, Jimmie. Why?"

"'Cause if it is, I kept about ten doctors away this morning."—Ex.

CANDOR

He: You used to say there was something about me you liked.

She: Yes; but you've spent it all now.
—Philadelphia Evening Ledger.

THE SYSTEM

First Trolley Conductor: Why was Kelley fired?

Second Trolley Conductor: His car struck a man at Steenth Street and carried him a block on the fender. After collecting a nickel for him, Kelly in the excitement, forgot to ring it up—and the man was a spotter!

Recruiting Officer: Any previous training?

Billjim: My oath! Y'orter see me killin' pigs.—Sidney Bulletin.

Bausch & Lomb Engineering Instruments

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You would want an investment to give a certain return--you know what your requirements are for the service from a transit or a level.

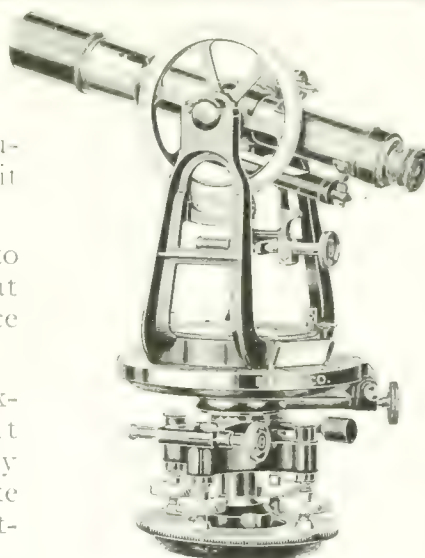
Behind your bond there must be excellent security--an instrument would be no good to you if it merely served today and tomorrow broke down, and failing to hold its adjustments gave inaccurate readings.

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EXCHANGE

"Where did you find this wonderful follow-up system? It would get money out of anybody."

"I simply compiled and adapted the letters my son sent me from college."—Kansas City Journal.

Physics Professor: "Now, young man, what is a vacuum?"

Young Man: "Why-er-er, well it's in my head, Professor; but I can't seem to think of it just now."—Browning's Magazine.

"How did Tom burn his hand?"

"Playing poker at the clambake."—Lampoon.

"If they enforce the Anti-Trust law, I'm ruined," sighed the Perpetual Borrower.—Jester.

Mike: "Sure an' the Irish are the finestest that bear arms in the war."

Sandy: "A 'weel mon, and what of the Heelerter?"

Mike: "Sure, they're the bestest with bare legs."—Chaparral.

FORTUNES OF WAR

First Recruit: What do you think of the major, Bill?

Second Recruit: 'T's a changeable kind o' bloke. Last night I says to him, "'Oo goes there," an' he says, "Friend," an' today 'e 'ardly knows me. Punch.

THE NAUGHTY OCEAN

"The Ocean," said the Minx.

The way that Minx behaves.

Her style is so conspicuous.

"The Ocean," said the Minx.

Chaparral.



HOTEL LENOX
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BOSTON

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 Clubs—your other
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Philanthropic Visitor: to jail-bird: My friend may I ask what brought you here?

Jail-bird: The same thing that brought you here, the desire to poke my nose into other people's business. Only I used to go in by the way of the basement window.—Tit-Bits.

SO HE WENT HUNGRY

A member of the Merion Cricket Club was telling stories to a Bryn Mawr girl. Here is what he said, which was considered the climax in wit for the evening:

Her eyes were not exactly straight, and some one commented upon it and asked him if he had noticed it

"Noticed it, man!" he replied "why she is so cross-eyed that recently when I sat next to her at a dinner she ate off my plate."—Philadelphia Ledger.

TO HELP HIM OUT

"You are lying so clumsily," said the observant judge to a litigant who was making a dubious statement of his case, "that I would advise you to get a lawyer."—Browning's Magazine.

Pater: Who is making that infernal jangle on the piano?

Mater: That's Constance at her exercise.

Pater: Well, for heaven's sake tell her to get her exercise some other way.—Transcript.

Once upon a time there was a race between a snail and a janitor.—Awgwan.

THE BARBER SHOPS AT
THE COPLEY-PLAZA **THE PLAZA**
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Some boys like to dance.



Some boys like to drink.



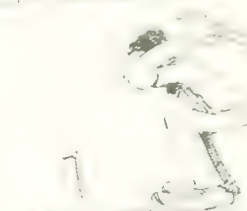
Some boys like to play the piano.



Some boys like to look through a telescope.



Some boys like to sleep on a table.



Some boys like to jump.



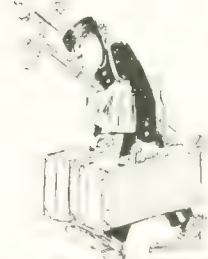
Some boys like to lie on the ground.



Some boys like to hold a flower.



Some boys like to walk with a cane.



Some boys like to sit on a suitcase.



Some boys like to sit on a chair.



Some boys like to dig.

THE WAY SOME OF THE BOYS SPENT THEIR VACATIONS



ARRIVES IN BOSTON



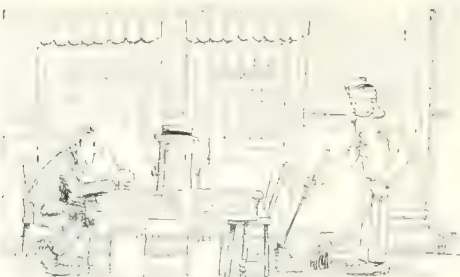
REGISTERS FOR THE TERM



SEES HOW EVERY ONE ELSE IN BOSTON WEARS BONE RIMMED SPECKS HE INVESTS IN A PAIR TOO



BEGINS TO REALIZE THE COMFORTS OF THESE HIGHLY RECOMMENDED CITY BOARDING HOUSES.



GOES TO HOTEL AND WRITES TO HIS BEST GIRL ON THE HOTEL STATIONARY



SPENDS HOURS ON THE ESPLANADE DEBATING WHICH GREEK LETTER ORDER TO FAVOR WITH HIS PRESENCE.



MEETS AN OLD HIGH SCHOOL CHUM AND IS SEEN STAGGERING OUT OF HUYLERS



STARTS OUT TO TAKE A BLUE BUS RIDE TO LEXINGTON AND CONCORD, AS THE HOME FOLKS SUGGESTED, BUT FINDS THE SCENERY OF BOSTON MUCH MORE ATTRACTIVE

HOW THE FROSH SPENT HIS FIRST FEW DAYS IN BOSTON

THE TECH "CAF"

The Place To Eat

BREAKFAST, 7:30 - 9

Coffee

LUNCHEON, 11 - 3

Coffee

DINNER, 5:30 - 7

Tea

NOT VERY

Betty Goldust: Did you have a satisfactory interview with papa?

Jack Brokeleigh: Not very; he said all he could give us was his consent.—Tiger.

CLOSE TO THE WALL

"Ivy, why don't you cling to me?"

He cried in whispers thick;

"Oh, Archibald, I will," she said,

"I think that you're a brick."

—Widow.

Martilla on a breezy day,

When you see chappies standing pat,
Why do you innocently say,

"What are those fellows looking at?"

Judge.

She: Did the doctor treat you?

He: No, he charged me five dollars.

—Jester.

First Sea Voyager (on rather rough trip): Ah, isn't the salt air bracing! The sea is good for a man!

Second Voyager (wanly): Yes, it certainly calls forth the best that is in you.
—California Pelican.



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Q THAT THE TECHNOLOGY MONTHLY ENGINEERING JOURNAL WAS THE MOST SATISFACTORY OF THE LOT;

Q THAT IT BROUGHT HIM MORE TRADE;

Q THAT AS A PUBLICATION HE WOULD RATHER READ IT.

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Q ARE YOU TAKING ADVANTAGE OF YOUR OPPORTUNITY?



ALFRED, AS A STUDENT IN THE
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ALFRED, AS A STUDENT IN THE
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ALFRED, AS A STUDENT IN THE
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ALFRED, AS A STUDENT IN THE
UNIVERSITY OF CHICAGO



THE ATTRACTION OF ALFRED TO THE
UNIVERSITY OF CHICAGO

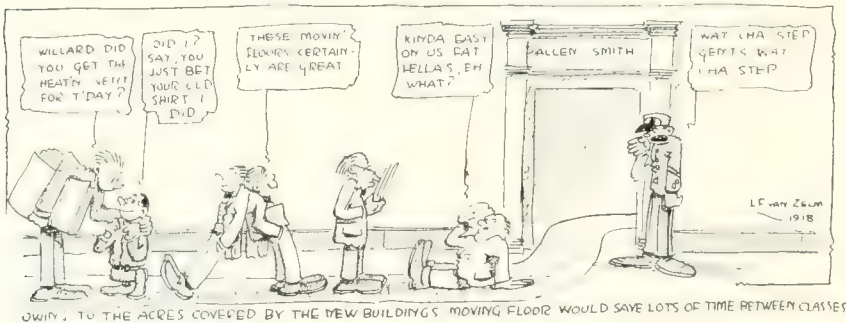


ALFRED, AS A STUDENT IN THE
UNIVERSITY OF CHICAGO



ALFRED, AS A STUDENT IN THE
UNIVERSITY OF CHICAGO

THE WAY ONE OF THEM SPENT HIS SUMMER



PROPOSED IMPROVEMENTS TO THE NEW TECH



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CONSTRUCTING ENGINEERS

NEW YORK

BOSTON

CHICAGO

WHAT SHE FEARED

He: Why so pensive—aren't you enjoying the prom?

She: Oh, yes, but I'm afraid people'll think I'm a co-ed.

Ted: Tom is trying to raise more money. I guess he has to remargin his stocks.

Ned: Yes; he told me the war brides he invested in are calling for more alimony.—The Lamb.

IT DIDN'T MATTER

"I want a loaf of bread."

"White or graham?"

"Doesn't matter; it's for a blind woman."—Topeka Journal.

Landlady: My rates are seven dollars up.

1920: But I'm a college student.

Landlady: Then my rates are seven dollars *down*.—Brunonian.

ANOTHER NARROW ESCAPE

Il (passionately)—Give me a——.

Elle: Sir!!!

Il (continuing)—Piece of candy?

Elle (continuing)—tainly.—Penn State Froth.

She: Papa says that unless you know how to make money you cannot marry me.

He: But if I marry you I do know how to make money.—Life.

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'PHONE 4960 BEACH

Ma—"Eddie, go out and bring in an
armful of wood."

"I won't," said the father, "till spring
comes around,

Ed.—"Aw, wait a minute. Pa will
be home with a load soon."

For bowling has only begun."

—Chicago News.

Miss Stout—"Harry told me last
night that I was worth my weight in
gold."

Miss Stake—"I didn't know there
was that much gold."

Yale's line averages about 200 pounds,
while the backfield figures but about 175.
The Philadelphia lightweights in front
and Baltimore bantams in back.—
Cleveland Leader.

"Oh father, dear father, come home to us
now,

The clock in the steeple strikes one!"

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